Dimensional Model

Central Hospital is a fictional general hospital located in more than 50 locations. Each local central hospital has more than 70 departments (e.g. Emergency, Allergy, Cancer Care, Pediatrics, Pharmacy), hundreds of doctors, nurses, and staff.

A special service provided by Central Hospital is patients have their medical accounts. They can deposit money in advance to their accounts with extra credits. For example, by depositing $75 in advance in the medical accounts, patients will receive $100 credits and can use them for paying all the bills generated by the hospital. There's no expiration date for the credits in the accounts.

Every time after a patient visited the central hospital, a bill will be generated. The majority of the bill will be paid by insurance companies. For the remaining balance of the bill, the patient can pay them using the credits from the medical account, cash, credit cards, debit cards, and so on.

Central Hospital wants to build a data warehouse and use the data warehouse to answer the following questions:
(1). Which local central hospitals, what departments and what doctors are generating most of the bills?
(2). Who are our patients, and how are they paying for their bills?
(3). What is the daily balance of credit in a medical account?
(4). What is the % used and % left of credits in the medical accounts given in a particular month?
(5). When filling claims to patients' insurance companies, what is the average duration between the claim filling date and the payment receipt date?

To answer the above questions, please design a dimensional model (star schema) to include all the necessary dimensions and facts by following the steps: (1). Identify the business process; (2). Define the grain; (3). Determine the dimensions; (4). Identify the facts; (5). Draw the star schema by connecting the tables. If you need more than one fact table in your model, please clearly define the grain of each fact table.

The design of the dimensional model is very flexible, you can include all the dimensions and facts you think are necessary for the model. Please clearly explain the reasons why you include certain dimension tables and fact measurements, and how they can further be used to answer the above questions. Please also indicate certain attributes you think are important in the tables.

For the definitions of dimension and fact tables, please use the metadata tables with the following columns:

Column Name	Nullable	Description

When you draw your final star schema, you don't need the full list of attributes in the tables, you can simplify your model by only including only the names in the tables:

Solution:

Step 1: Identifying the business process

Bill payment system of the Central Hospital; Patients paying the bill via their medical accounts at the Central Hospital; Payment using the Insurance claims, the credits from the medical account, cash, credit cards, debit cards, etc.

Step 2: Defining the grain

(1) Each record of the patient per visit to a Central Hospital location with specification of a local department and the assigned doctor and payment made using the credits from the medical account
(2) Patient claims the insurance to pay the bill
(3) Patient pays bill using credit card, debit card

Step 3: Determining the dimensions

Location dimension, Department dimension, Nurse dimension, Staff dimension, Doctor dimension, Patient dimension, Date dimension, Medical Account dimension, Insurance Company Dimension

Location Dimension: Help maintain the details regarding each location of the Central Hospital and track the facility better

Column Name	Nullable	Description
Location ID	No	PK
Location Name	No	NK
Location Address	No	
Location Zipcode	Yes	
Location E-Mail Address	Yes	
Location Phone Number	No	
Number of Rooms	No	
Number of beds	No	
…		

Department Dimension: Help maintain the details regarding each department of the Central Hospital and track various activities under all departments

Column Name	Nullable	Description
Department ID	No	PK
Department Name	No	NK
Wing Number	No	
Number of rooms	No	
Department E-Mail Address	No	
Department Phone Number	No	
…		

Nurse Dimension: Separate detailing will help in maintain authenticity of each nurse and their skills/specialty; It will help in assign the right nurse for respective department

Column Name	Nullable	Description
Nurse ID	No	PK
Nurse Name	No	NK
Nurse Designation	No	
Nurse Gender	No	
Date of Birth	No	
Age	Yes	
Nurse Address	No	
Nurse Zipcode	Yes	
Nurse E-Mail Address	Yes	
Nurse Phone Number	No	
Nurse Skills	Yes	
Nurse Specialty	No	
Work Slot	No	
…		

Staff Dimension: Separate detailing will help in maintain authenticity of each staff member and their specialty helping further in assigning them for the right work in the Hospital

Column Name	Nullable	Description
Staff ID	No	PK
Staff Name	No	NK
Staff Designation	No	
Staff Gender	No	
Date of Birth	No	
Age	Yes	
Staff Address	No	
Staff Zipcode	Yes	
Staff E-Mail Address	Yes	
Staff Phone Number	No	
Staff Specialty	No	
Work Slot	No	
…		

Doctor Dimension: Maintaining the detailed records about each doctor will assist in correct assignment and hence, correct medication of patients

Column Name	Nullable	Description
Doctor ID	No	PK
Doctor Name	No	NK
Doctor Designation	No	
Doctor Specialty	No	
Doctor Gender	No	
Doctor Date of Birth	No	
Doctor Address	No	
Doctor Zipcode	No	
Doctor E-Mail Address	No	
Doctor Phone Number	No	
Doctor Alternate Phone	Yes	
Doctor Skills	No	
Work Slot		
…		

Patient Dimension: Keeping a detailed record of patients can help in their medication throughout

Column Name	Nullable	Description
Patient ID	No	PK
Patient Name	No	NK
Patient Visit Number	No	
Patient Latest Visit Date	No	
Patient Address	No	
Patient Zipcode	Yes	
Patient Phone Number	No	
Patient E-Mail Address	Yes	
Patient Gender	No	
Patient Date of Birth	No	
Patient Age	No	
Medical Concern	No	
Medical History	No	
…		

Date Dimension: A required table for keeping Date and Time record of each activity taking place in the Central Hospital

Column Name	Nullable	Description
Date ID	No	yyyymmdd (PK)
Date Value	No	Mm/dd/yyyy (date type)
Day of Week	No	
Holiday Indicator	No	
Time of the day	No	
…		

Medical Account Dimension: Maintaining detailed record of the medical accounts of patients will assist in providing credits, if paid in advance and can be used to digitalize all the medical reports of each patient. Hustle free and an easily retrieval system whenever needed.

Column Name	Nullable	Description
Medical Account ID	No	PK
Credits Earned Value	No	
Advance Payment Value	No	
Credits Used Value	No	
Credit Balance Value	No	Kept updated whenever credits transaction made
Account created Date	No	
…		

Insurance Company Dimension: To keep a record of all the insurance companies which are affiliated and verified by the Hospital. To find if the hospital accepts a specific insurance companies claim. This helps in keeping authenticity.

Column Name	Nullable	Description
Insurance Company ID	No	PK
Insurance Company Name	No	NK
…		

Step 4: Identifying the facts

Bill Transaction Fact, Insurance Claim Transaction Fact, Card Payment Transaction Fact

Bill Transaction Fact:

Column Name	**Nullable**	**Description**
Location ID	No	FK
Department ID	No	FK
Nurse ID	No	FK
Staff ID	No	FK
Doctor ID	No	FK
Patient ID	No	FK
Date ID	No	FK
Medical Account ID	No	FK
Total Bill Amount Value	No	
Invoice Number	No	
Invoice Date	No	
Patient Admit Date	No	
Patient Discharge Date	No	
Number of Days admitted	No	Total number of days a patient was kept admitted in the Central Hospital
Admit Room Number	No	Room in which the patient was admitted
Room Type	No	Premium / Private / Public / etc.
Payment Modes	No	Insurance Claim / Medical Account Credits / Credit Card / Debit Card / Others
Medical Account Credit Value Spent	Yes	Null only if the bill was NOT paid using the credits of the medical account
Balance Amount	No	Value of bill yet to be paid
Payment modes used	No	Mentioning all the payment modes used to pay the full bill
…		

Insurance Claim Transaction Fact:

Column Name	Nullable	Description
Location ID	No	FK
Department ID	No	FK
Staff ID	No	FK
Doctor ID	No	FK
Patient ID	No	FK
Date ID	No	FK
Medical Account ID	No	FK
Insurance Company ID	No	FK
Insurance Type	No	
Invoice Number	No	Mention the main invoice number from Bill Transaction Fact table, to keep the track
Invoice Date	No	Mention the main invoice date from Bill Transaction Fact table, to keep the track
Bill Amount Value	No	
Patient Insurance ID	No	
Insurance Claim Value	No	
Insurance Claimed Date	No	
Payment Received Date	No	
Balance Amount	No	Value of bill yet to be paid
…		

Card Payment Transaction Fact:

Column Name	Nullable	Description
Location ID	No	FK
Department ID	No	FK
Staff ID	No	FK
Doctor ID	No	FK
Patient ID	No	FK
Date ID	No	FK
Medical Account ID	No	FK
Invoice Number	No	Mention the main invoice number from Bill Transaction Fact table, to keep the track
Invoice Date	No	Mention the main invoice date from Bill Transaction Fact table, to keep the track
Bill Amount Value	No	
Card Type	No	
Card Holder Name	No	
Card Details	No	
Balance Amount	No	Value of bill yet to be paid
…		

Tables which will help answering the following questions:

(1). Which local central hospitals, what departments and what doctors are generating most of the bills?
Location Dimension table, Department Dimension table, Doctor Dimension table, Bill Transaction Fact table, Insurance Claim Transaction Fact table and Card Payment Transaction Fact table

(2). Who are our patients, and how are they paying for their bills?
Patient Dimension table, Medical Account Dimension table, Bill Transaction Fact table, Insurance Claim Transaction Fact table and Card Payment Transaction Fact table

(3). What is the daily balance of credit in a medical account?
Medical Account Dimension table

(4). What is the % used and % left of credits in the medical accounts given in a particular month?
Medical Account Dimension table and Bill Transaction Fact table

(5). When filling claims to patients' insurance companies, what is the average duration between the claim filling date and the payment receipt date?
Insurance Claim Transaction Fact table

Step 5: Drawing the star schema by connecting the tables